CLAIMS

1. A mounting arrangement, comprising:

a fuel rail;

a fuel injector cup connected to the fuel rail, the fuel injector cup having a fuel communication area defining a longitudinal axis, a fuel rail mounting section, and a retaining surface;

a fuel injector including a fuel metering end and a fuel inlet end, the fuel inlet end being exposed to the communication area; and

a fastener that secures the fuel injector to the fuel injector cup and allows the fuel injector to reciprocate along the longitudinal axis of the fuel injector cup.

2. The mounting arrangement of claim 1, wherein the fuel injector cup comprises a cylindrical tube, the fuel rail mounting section being located at a first end of the tube, the retaining surface being located at a second end of the tube; and

wherein the fuel injector comprises a housing having a retention groove.

3. The mounting arrangement of claim 2, wherein the fastener comprises a clip having a wall and a pair of legs projecting from the wall, the pair of legs straddling both the fuel injector cup and fuel injector, each leg having a tab and a window, the tab having a mating surface that engages the retention groove of the fuel injector housing, the window having a frame that engages the retaining surface of the fuel injector cup.

4. The mounting arrangement of claim 3,

wherein the retaining surface comprises a lip located at the second end of cylindrical tube, the lip extending away from the longitudinal axis;

wherein the frame comprises a pair of landing edges configured so that, when the fuel injector is located at a first position along the longitudinal axis, the lip of the fuel injector cup engages one of the landing edges, and when the fuel injector is located at a second position along the longitudinal axis, the lip of the fuel injector cup engages the other of the pair of landing edges.

5. The mounting arrangement of claim 4,

wherein the retention groove comprises a channel that partially encircles the housing of the fuel injector, the channel including a first end and a second end;

wherein each of the tabs on each of the legs include a stop that abuts the first end and the second end of the channel, respectively, to constrain relative rotation between the fuel injector and the fuel injector cup.

6. The mounting arrangement of claim 5, further comprising an air induction device having an aperture, the metering end of the fuel injector comprising a face seal that mates with the aperture when the fuel injector is located at one of the first position and the second position along the longitudinal axis.

7. The mounting arrangement of claim 6, wherein the mounting arrangement comprises a production assembly having the clip installed by an automated process, the production assembly being capable of satisfying at least an appropriate assembly integrity test and environmental vibration test.

8. A mounting arrangement, comprising:

a fuel rail;

a plurality of fuel injector cups connected to the fuel rail, each of the fuel injector cups including a cylindrical tube defining a longitudinal axis, a fuel rail mounting section disposed at a first end of the tube, and a lip at a second end of the tube;

a plurality of fuel injector, each fuel injector corresponding to one of the plurality of fuel injector cups, each fuel injector having a housing including a fuel metering end, a fuel inlet end, and a retention groove, the fuel inlet end of the fuel injector 16 being disposed within the cylindrical tube of the fuel injection cup; and

a clip that engages both the lip of the fuel injector cup and the retention groove in the housing of the fuel injector to secure the fuel injector to the fuel injector cup and allow the fuel injector to reciprocate along the longitudinal axis extending through the cylindrical tube of the fuel injector cup.

9. The mounting arrangement of claim 8, wherein the clip comprises a wall and a pair of legs projecting from the wall, the pair of legs straddling both the fuel injector cup and fuel injector, each leg having with a tab and a widow, the tab having a mating surface that engages the retention groove in the housing of

the fuel injector, the window having a frame that engages the lip of the fuel injector cup, the frame having a pair of landing edges extending along the corresponding leg, the pair of landing edges on the frame configured so that, when the injector is located at a first position along the longitudinal axis, the lip of the fuel injector cup engages one of the landing edges, and when the injector is located at a second position along the longitudinal axis, the lip of the fuel injector cup engages the other of the pair of landing edges.

10. The mounting arrangement of claim 9,

wherein the mounting arrangement comprises a production assembly having the clip installed by an automated process;

wherein the production assembly is capable of satisfying at least an appropriate assembly integrity test and environmental vibration test.

11. The mounting arrangement of claim 10,

wherein the assembly integrity test includes: (1) an air leakage test in which the production assembly must have an air leakage rate of no greater than 2.5 cc/min when the production assembly is pressurized to no greater than 600 kPa; and (2) a liquid immersion test in which the production assembly when at a stable pressure of no greater than 500 kPa and submerged in a test fluid for 30 seconds no bubbles appear in the test fluid; and

wherein the environmental vibration test includes, while vibrating the production assembly for a minimum of 15 hours in a longitudinal, lateral, and vertical direction at varying frequencies no greater than 600 Hz sinusoidal, subjecting the production assembly to at least: (1) a thermal cycle test over a range of

approximately -40 to 140°C; and (2) a pressure cycle test of at least 30,000 cycles over a range of approximately 0 to 1500 kPa.

12. A clip for securing a fuel injector to a fuel injector cup on a fuel rail, the fuel injector having a housing with a retention groove, and the fuel injector cup having a lip, the clip comprising:

a wall having a first end and a second end;

a first leg projecting from the first end of the wall, the first leg including a first tab and a first window; and

a second leg projecting from the second end of the wall, the first leg and the second leg being substantially parallel, the second leg including a second tab and a second window;

wherein the first tab and the second tab have a corresponding mating surface configuration adapted to engage the retention groove in the housing of the fuel injector; and

wherein the first window and the second window each have a substantially similar frame adapted to engage the lip of the fuel injector cup, each of the frames having a pair of landing edges extending along the corresponding leg, the pair of landing edges on each of the frames being spaced so that engagement of one of the landing edges with the lip of the fuel injector cup is exclusive of engagement of the lip of the fuel injector cup with the other of the landing edges.

13. The clip of claim 12, wherein the frame of each of the legs further includes a pair of side edges between the landing edges so that the frame has a substantially rectangular configuration.

14. The clip of claim 13, wherein the frame of each of the legs further includes a pair of side edges between the landing edges, each of the side edges having a length approximately half the length of one of the landing edges.

15. A method of mounting a fuel injector to a fuel injector cup on a fuel rail so that the fuel injector is secured to the fuel injector cup and the fuel injector can be positioned along a longitudinal axis defined by the fuel injector cup, the method comprising:

providing a fuel rail with at least one fuel injector cup, the at least one fuel injector cup including a retaining surface;

locating at least one fuel injector proximate the at least one fuel injector cup, the at least one fuel injector having a housing with a retention groove; and

securing the at least one fuel injector to the at least one fuel injector cup with a fastener that engages both the retention surface of the fuel injector cup and the retention groove in the housing of the fuel injector.

16. The method of claim 15, further comprising:

providing a lip on the fuel injector cup as the retaining surface and a channel partial encircling the housing of the fuel injector as the retaining groove; and

providing a metal clip as the fastener, the clip comprising a wall and a pair of legs projecting from the wall, the pair of legs straddling both the fuel injector cup and fuel injector, each leg having with a tab and a window, the tab having a mating surface that engages the channel in the housing of the fuel injector, the window having a frame that engages the lip of the fuel injector cup, the frame having a pair of landing edges extending along the corresponding leg, the pair of landing edges on the frame configured so that, when the fuel injector is located at a first position along the longitudinal axis, the lip of the fuel injector cup engages one of the landing edges, and when the fuel injector is located at a second position along the longitudinal axis, the lip of the fuel injector cup engages the other of the pair of landing edges.

17. The method of claim 16, further comprising:

installing the clip with an automated process so that the at least one fuel rail, the at least one fuel injector, and the clip comprise a production assembly capable of satisfying at least an appropriate assembly integrity test and environmental vibration test.

18. The method of claim 18, further comprising:

providing an air induction device having an aperture so that a face seal on a metering end of the fuel injector mates with the aperture when the fuel injector is located at one of the first position and the second position along the longitudinal axis.